Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
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Effects of Communications Towers on Migratory Birds	)	WT Docket No. 03-187
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To the Commission:

Formal Comments of Nickolaus E. Leggett

I am a certified electronics technician (ISCET and NARTE) and an Extra Class amateur radio operator (call sign N3NL). I am an inventor holding three U.S. Patents. My latest patent is a wireless bus for digital devices and computers (U.S. Patent # 6,771,935). I have a Master of Arts degree in Political Science from the Johns Hopkins University.

My comments discuss the use of tall communications towers and the protection of migratory birds.

Why Tall Communications Towers are Used

Tall communications towers are built to increase the line-of-sight range of radio signals and the coverage area of radio communications. The distance of the radio horizon increases significantly as you increase the height of the antenna above ground level.

The distance of the radio horizon in miles is equal to the square root of

the product of 2 times the height of the antenna in feet (Reference One)

Applying this formula to a 200-foot high antenna tower indicates a radio horizon of 20 miles. Applying the same formula to a 1000-foot high tower indicates a radio horizon of 44.7 miles. Clearly there is a significant benefit in range and a much larger coverage area for a taller antenna tower.

There are numerous towers over 1,000 feet in height above the ground and there are a few towers over 2,000 feet in height. Most of these towers are built for broadcasting purposes. Detailed information on these towers can be found on the Commission's web site (Antenna Structure Registration) and a quick look at them is available online on Wikipedia. Also if you consult an aviation sectional map you will see the tall towers located on it.

Alternatives to Tall Antenna Towers

There are physical alternatives to tall antenna towers for some applications. For example, you can broadcast via cable or fiber optic communications lines without using tall towers at all. However, this alternative is very expensive unless you have a high density of users to pay for the high costs of any land-line communications distribution system. A tower is a comparatively cheap system for reaching a large number of listeners/viewers. The tall tower is especially effective for reaching large rural areas with lower population density.

In addition, cable and fiber optic distribution systems cannot directly

reach mobile users. If you wanted to reach mobile users with cable and/or fiber lines you would need numerous relay stations connecting your network to the mobile users. As can be seen in current cell phone systems fairly significant towers are still required to link mobile users into the telephone system.

Another alternative is satellite communications links and satellite broadcasting. These are certainly available but they are relatively costly and not always a good solution for the particular market or application.

High flying robotic aircraft will eventually compete directly with some tall towers. These aircraft would fly in patterns for long periods of time above 60,000 feet. Each aircraft would carry relay systems and would be fueled by stored solar energy or by microwave power beamed to a rectifying antenna (rectenna) on the aircraft. It will be a while before such flying relay stations reach the marketplace.

Future Uses of Tall Towers

In the future there may be additional markets for tall towers. As the use of higher frequencies including the millimeter waves and light waves increases there will be an increased need for tall towers because these frequencies are even more of a line-of-sight phenomenon that can easily be blocked by obstructions. These new frequency bands are highly desirable because they have a huge capacity for new communications channels.

In addition, tall communications towers can be used to support

weather and environmental monitoring devices and systems at various heights above the ground. This can include the active real-time tracking of pollutants and warning of potential biological attack materials in the air.

The tall towers can also be used for tracking suitable equipped vehicles on the ground and automatically detecting, locating, and reporting accidents that occur.

A Lasting Market for Tall Towers

All of the above observations indicate that tall communications towers have a lot to offer to communications in the future. Indeed, some engineers have speculated that much taller towers and even "space elevators" will be built for future purposes. As a result, of this, solutions for protecting migratory birds will have to be compatible with the future existence of tall communications towers.

Using Sound to Make Towers "Visible" to Birds

The various comments to date have been how to make tall communications towers effectively visible to birds so they can avoid them. However, there is the alternative of generating sound to warn the birds of the presence of a tower.

As the balloon pilots will tell you, there is usually wind present as you ascend above the ground. At the ground it can be dead calm and yet just a few feet up there is a reasonable breeze blowing. This means that you can establish wind-driven whistles that will warn the birds of the presence of the

tower and its guy wires. You could construct a 1000-foot tower and equip it with a wind whistle every 10 feet for its upper 800 feet. This would require the use of 80 wind-driven whistles to serve the entire tower. A substantially greater number of whistles would be needed if one needs to place whistles along the length of the guy wires as well as along the tower itself.

A related alternative technology would be gongs or sounding devices like wind chimes that would be installed at points along the tower. This alternative would be less likely to be blocked or inhibited by ice collection during winter storms.

A more high tech alternative would be solid state sound sources driven by wired electric power or small solar cell installations. Solid state sound sources may be better for installation along guy wires.

All of these noise-making technologies would have to be engineered so they would not make a hideous racket for nearby people and yet still would effectively warn the migratory birds.

It is probably worth while for the Commission to cooperate with a university engineering or architectural department to develop prototype sound warning devices for birds and to test these devices on an actual communications tower. In many climatic conditions, sound warnings may be better than visual warnings.

Respectfully submitted,

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Reference One: The ARRL Handbook for Radio Communications 2006, The American Radio Relay League, Newington, CT, Page 20.19